A Shallow-Water Swath Bathymetry System

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LONG-TERM GOAL

Our long-term goal is to determine and understand the processes which create and modify the sea bed in the coastal zone through use of swath-mapping techniques (for bathymetry and backscatter) optimized for shallow-water use.

OBJECTIVES

Swath-mapping techniques have proven extremely valuable to the study of sea-floor morphology on continental shelves, slopes and margins, mid-ocean ridges and in the deep ocean, but systems designed for continental shelf and deeper-water environments are not optimized for the shallow-water of coastal settings. Swath-mapping systems optimum for shallow water have recently become available; however, no shallow-water systems have existed in the U.S. academic community for use in research programs. Our objective is to fill this critical gap by obtaining, installing, and demonstrating the data quality of a shallow-water swath bathymetry system that can be moved between vessels as required. This kind of high-resolution morphological data will contribute to ONR programs in the coastal zone such as STRATAFORM.

APPROACH

We are building a shallow-water swath bathymetry system designed around a Kongsberg Simrad EM 3000 multibeam echosounder which can operate in water depths of 0.5 to over 100 m. Other major system components include a TSS POS/MV (navigation and attitude), Sun and SGI computers (data processing and display), gyroscope (heading), CTD (sound velocity structure) and tide gauge (water level). The EM 3000 operates at 300 kHz with a maximum swath width of 4 times water depth and a pulse repetition rate of up to 20 pings/second in water. The are 127 beams with nominal widths of 1.50, and the accuracy of the depth measurement is 5 cm. In water depths of 10 m and at a speed of 10 kts, this results in a spacing of about 20 cm between depth measurements in both along track and across track directions. This resolution is sufficient to map medium to large-scale bed forms and other features with dimensions of about 1 meter. The EM 3000 also collects backscatter data and seabed imagery (side-scan sonar) which is processed with a knowledge of seafloor bathymetry. We will install the system on the R/V Onrust, a 60-foot research vessel operated by the Marine Sciences Research Center at Stony Brook, but the installation is not permanent and the system can be moved between vessels as

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research opportunities arise. This project is a cooperative effort between this group and Dale Chayes and Jay Ardai at the Lamont-Doherty Earth Observatory. Chayes and Ardai are providing support for the installation and operation of this system on the R/V Onrust and other vessels through a separate contract from ONR while Flood et al. are purchasing the equipment and directing the logistical and scientific operations.

WORK COMPLETED

The items in our basic system have been purchased, installed, and integrated into a system on the R/V Onrust. We have demonstrated that the system (nicknamed HIRSUTE [HIgh Resolution Shallow Water Undersea Topography System]) collects high-quality data depth, backscatter, and imagery data. The portability of the system has been demonstrated in that the system, including transducer, has been installed on and removed from the R/V Onrust two times to allow for the vessel to be used by workers in other disciplines. We have recently completed a short test cruise in the New Jersey STRATAFORM area to collect EM 3000 data to be compared in detail with EM 1000 data collected previously by the CCGC Creed. We have also installed software from the Ocean Mapping Group at the University of New Brunswick on our computers for post-processing and display of multibeam data.

RESULTS

Initial results of our surveys have demonstrated the high-quality of the EM 3000 data products and the range of morphological elements resolvable by the system. Indeed, our results have already provided new insight into the range of processes important for generating the morphology of the sea floor in the coastal ocean. We have used the system on the R/V Onrust at speeds up to 10 knots and up to sea state 5. We have been able to resolve sand waves in water depths of 17 m, and we have found several shipwrecks, most of which are not shown on existing charts. Other elements resolved include large boulders with moats, bedrock outcrops, sand mining pits, drag marks, buoy anchors, and unusual morphology apparently created by a hard-substrate communities (including corals and sponges). Results from the collection and comparison of EM 3000 and EM 1000 data in the New Jersey STRATAFORM area are expected shortly. A second comparison in the west coast STRATAFORM area off Eel River is planned for summer, 1999. Installing the system on a west-coast vessel will be part of the second comparison study.

IMPACT/APPLICATIONS

Our work to date clearly demonstrates the high quality of the data generated by the EM 3000 system and the importance of multibeam data in understanding seabed morphology in the coastal regions. The system can be installed on a variety of vessels after the design and installation of appropriate mounting systems. Use of the system by our group and others in a number of environments in support of a wide range of problems is anticipated and encouraged.

TRANSITIONS

We are in the testing and evaluation phase for our system, but we anticipate that the this system will become an important part of many coastal study programs.

RELATED PROJECTS

This EM 3000 system is being used in two surveys starting in late 1998. Shinnecock Inlet (Long Island south shore) was surveyed as part of a study of inlet dynamics being undertaken by WES (Waterways Experimental Station, US Army Corps of Engineers). Thirty-five miles (in four segments) of the Hudson River will be surveyed as part of a NYSDEC (New York State Department of Environmental Conservation) study of benthic habitats. Some of our survey data from the New Jersey STRATAFORM site will also be used to support the scientific drilling programs being proposed by Austin, Mountain, and others.